TREATMENT

OF

PARALYSED MUSCLES

BY

ELASTIC RELAXATION.

By JNO. P. VAN BIBBER, M.D.

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At the present time, when a new vigor seems to have been imparted to the study of the nervous system, I deem it peculiarly fit to bring to the notice of the Society some observations which have lately been made concerning the condition of muscles in various forms of paralysis.

And I do so more willingly, because it is evident to me that the morbid conditions of the muscular system have up to this time been too little investigated, and I feel convinced that the day is not far distant when the nosology of muscular diseases will be very materially increased. Taking into consideration the fact that the muscular tissue constitutes nearly one-half the entire mass of the human body, or according to Ranke .45, and that the process of nutrition and assimilation is carried on to a great extent in this system, we must be impressed with the important influence which, either in health or disease, this large mass of tissue exerts upon the economy. Indeed, Flint in his *Physiology*, vol. ii, p. 449, says, "that the condition of the muscular system is an almost unfailing evidence of the general state of the body." To show clearly the practical importance of the theory which I shall here endeavor to develop, I would beg leave to call your attention briefly to the anatomy of muscular fibre, in order more intelligently to explain the curative action of elastic relaxation applied to paralysed muscles.

According to Flint, voluntary muscles are made up of a great number of microscopic fibres called primitive muscular fasciculi. The structure of these fasciculi is complex, but they may be divided longitudinally into fibrillæ, and transversely into disks, in such a manner as to render it doubtful as to what, strictly speaking, is the ultimate anatomical element of muscular tissue. A primitive muscular fasciculus runs the entire length of the muscle,

and varies much in size in different individuals. As a rule they are smaller in young persons and females than in adult males. As a muscle is better developed, so the fasciculi increase in size, and it is probably due to this fact rather than to the formation of any new elements, that we have the enlargement of a muscle under constant exercise. These fasciculi are gathered into bundles and surrounded by connective tissue; and a certain aggregation of bundles so formed constitutes a muscle.

The circulation in muscles is very abundant, and the capillary vessels are arranged somewhat peculiarly, and are the smallest in the whole body. According to Köllike, when distended with blood, they are from $\frac{1}{4200}$ to $\frac{1}{3700}$ of an inch in diameter, and when empty their diameter is from $\frac{1}{7000}$ to $\frac{1}{5500}$ of an inch. The capillaries are distributed to each primitive fasciculus, and their long diameter follows the direction of its fibres.

Now it is evident from this anatomical construction that the diameter of these vessels is much influenced by the position of the muscle. If it be relaxed, the diameter of the capillaries would be greater; if it be stretched to any extent, the diameter would be very materially diminished. On the other hand it is equally evident that in the contraction of a muscle the circulation is also influenced to some degree; but as that is not of as much importance in this discussion, it is only mentioned as a fact.

I would wish to call attention to the fact that a muscle is so formed, its fibres and circulation so arranged, that it cannot remain in a fixed position, contracted, relaxed, or stretched, for any length of time without suffering grave disturbances in its nutrition. Movement seems to be absolutely necessary for the healthy development of muscle, and hence we can readily infer that a certain amount of motion is essential for the well-being of the component parts of this tissue. Even a perfectly relaxed position, with the antagonistic muscles acting normally, I do not think could long be sustained without some interference to the circulation. If then a healthy muscle depends to such an extent upon movement for the integrity of its condition, we can easily imagine that the loss of motion of paralysed muscles is not an unimportant factor in their degeneration.

Therefore in some forms of paralysis, when a muscle, or group of muscles, is forced by its antagonists into an abnormal and comparatively fixed position, I do not think that treatment wise or efficient which only endeavors to cure the nervous lesion, or at best totally neglects the unphysiological condition of these paralysed muscles. For in such a case of paralysis, we not only have the muscles incapable of receiving the influence of the will, but not being capable of motion or contraction, they are injured, first, by the fibres themselves being intensely stretched; second, by the circulation being undoubtedly interfered with; third, by the commencing atrophy or degeneration which must accompany any continued diminution of the circulation.

To recapitulate the various disadvantages under which a muscle so affected is placed, I would say, first, the loss of the nervous influence of the will; second, the inactivity of the muscular fibre; third, its stretched and elongated position; fourth, the contraction of the blood vessels, and consequent anæmia and loss of temperature.

Heretofore, too little attention has been given to the treatment of the muscles themselves in some of the more curable forms of paralysis, and I refer with some pride to an article in the *New York Medical Journal*, May 1874 — that proposed a plan of treatment, which if not entirely new, at least brought forward some new arguments and considerations in regard to a closer investigation of the condition of paralysed muscles. Before attempting to call attention to the injurious way in which such stretching of the muscle may affect the ultimate distribution of nerve-fibre, I will endeavor to show how the elastic relaxation of paralysed muscles will better their condition and promote recovery.

In the article before referred to, in alluding to the use of an artificial extensor muscle in a case of lead paralysis, I gave the following opinion of its advantages and usefulness: "Perfect relaxation of muscle by mechanical means would not, I am confident, accomplish the results I have seen from the use of this instrument, and at the same time would not give to the patient as useful a hand. For here, without having power in the extensor group, we simulate, as nearly as possible, nature herself; and in the daily uses of the

arm, by alternate relaxation and contraction, we bring the muscles as near their normal movements as the deformity will allow. And I would place great emphasis upon this point, that in these changes of position we have changes in circulation; that when the muscle is intensely stretched, the capillary vessels are pressed upon and their calibre reduced; while on the other hand, in a relaxed condition of the muscle, nutrition can go on with less interference. Certainly in health, only by movement and exercise can we produce developed muscle. Therefore, when the power of motion is lost, when paralysis has deprived any muscle of an element so important to them in their normal state, we should, in our treatment, endeavor to imitate their natural action as the surest means of bringing about recuperation."

The first example which will be brought forward as a successful proof of the efficacy of this treatment, is a case of Ptosis that came under my observation at the New York Eye and Ear Institute. The patient had been under treatment for some weeks, but the paralysis was not in the least improved. My friend, Dr. John J. Mason, of the Department for Nervous Diseases of the Institution, had tried as efficiently as possible the effect of faradization, with no result whatever. It occurred to me that if the stretched fibres of the Levator palpabræ superioris could be relaxed, and the lid kept up by an artificial levator muscle, that a great step would be made towards his recovery. Accordingly, a thin and elastic ribbon of India rubber was attached to the upper lid, at the highest point of its convexity, and as near to the lashes as possible, by means of minute strips of court-plaster, which, when dry, were painted over with collodion. The lid was then drawn up by this muscle to a natural position, and the ribbon attached by the same means to the forehead just above the eyebrow.

Conrad McEroe, aged forty-three, carver in a restaurant, stands much over hot dishes in carving and is exposed to draughts. No syphilitic history, paralysis of lev. palp. sup. and rectus sup. Ptosis, probably of rheumatic origin, or in other words "coup de vent." Has been treated for three weeks by electricity, and hydrarg. bi-chloride and potass. iodide, with no success. The first

artificial muscle applied, remained on five days. The patient showed decided improvement. The next muscle remained on ten days, and the next three days. At each examination he was found to be improved, and after eighteen days of treatment it was found that his eye would remain two-thirds open, and that he could close the eye and open it to that extent an indefinite number of times. It was, however, thought best to apply it again, and by this means and the aid of electricity the affected muscle was soon entirely restored.

I had the pleasure of showing this case to the Society of Neurology and Electrology of New York, and also mentioned it in the article before alluded to, in the following words : "The patient experiences much comfort from the appliance, as, the recti muscles being but slightly involved, he is rarely troubled with diplopia. The elasticity of the rubber allows the patient to close the eyes, but upon ceasing muscular effort the eye is again opened."

In this case the artificial levator had not only to overcome the antagonism of the orbicularis, but also the counteracting force of gravity, for the upper eye-lid of an adult is of some appreciable weight. I look upon this as a type case, for it had long resisted the treatment of electricity, and it was only after prolonged relaxation and weeks of artificial motion that the fibres of this muscle were able to resume their natural functions.

The case of lead paralysis in which I first used the artificial extensor muscle was also a very instructive one, showing the value of this treatment when all others had failed.

Frank Fitzimmons, age 45, painter ; blue line on gums, and lead cachexia well marked. Has had colic, and paralysis of extensors has lasted eight months. Prognosis bad. Has not improved at all under constant electrical treatment. Extensors are entirely useless ; and flexors, when motion is attempted, bend the hand at a right angle with the forearm. The temperature of the extensor surface of the arm is perceptibly diminished. The elastic relaxation was applied as I have described it in *N. Y. Med. Journal*, May, 1874, forming a very useful and efficient extensor muscle. He continued to wear this apparatus for about 3 months, and at the time of my leaving New York was able to resume light work, having full

power over the extensors of the wrist, but not having yet fully recovered the use of the extensors of the fingers. I should not neglect to say that during this time the treatment by electricity was continued; but as he had so long resisted that treatment, and received no benefit from its use alone, I think his recovery may be truthfully attributed to the curative action of the elastic relaxation.

Dr. Detmold, *New York Med. Journal*, May, 1873, published a case of facial paralysis treated by an apparatus which, though it relaxed the muscles, was not elastic, and which was thought to have a curative effect on account of the current of electricity that passed continually through it. It consisted of two different metals, made in the form of a double hook, one end to pass behind the ear and the other into the angle of the mouth. The hook behind the ear was armed with a small sponge, which was kept moist with dilute vinegar, and the one in the mouth obtained its moisture from the saliva. This instrument was tested by a galvanometer and a perceptible current found to be generated by it. Dr. Detmold, in his article, questions whether it was the electricity or the relaxation that benefited this case so much.

I am inclined to believe it was entirely due to the relaxation, although it lacked the most important element of elasticity. A small hook to hold up the angle of the mouth, attached by a band of rubber around the ear, is a much more effective apparatus; and it was tried several times at Dr. Seguin's clinic, and also at the Bellevue, but with what result I am unprepared to say. Dr. Detmold was kind enough to say in New York Academy of Medicine, that he thought the elastic apparatus would accomplish much more than the one he had first devised.

I will now come to the consideration of the nervous element of the treatment proposed and carried out in the cases just related. In paralysis of all kinds, heretofore, we have looked almost entirely to the lesion existing either in the nerve-centres, or in the course of the nerve some distance from its distribution to the affected muscles. Of course for purposes of diagnosis this is not only important but necessary; yet I would wish to show that no treatment should be governed by this idea alone, but that we must

take into consideration the paralysed muscles, and give them some share of attention.

The intimate anatomical relation existing between the ultimate nerve filaments and the muscular fibrillæ, is not only a strong argument for giving our treatment a local character, but it is a physiological fact which if overlooked would tend to retard beyond measure the recovery of the paralysed muscles. If it can be shown that a nerve, besides the nutrition that it has from the circulation in its course, derives a separate and distinct source of nourishment from its distribution to the muscular fibre, it will be evident that any effort to better the condition of the muscles would be followed by corresponding improvement in the distal portion of the nerve. In a grave central lesion, as we could hardly hope to effect any permanent relief, such endeavor would be of no avail. But in many cases of paralysis, especially such as I have related, I think the theory is one which should prove itself successful in practice.

The termination of the ultimate filaments of nerves in the fibres of muscular tissue is a subject that has given rise to much discussion. But whatever may be the explanation of the question, this fact is beyond all doubt, that the nerve-tissue and muscle-fibre are very closely and intimately connected, and that the nutrition of both these tissues as they merge into one another is probably carried on by the same blood-vessels.

In fact, it has been demonstrated by experiment, that if a nerve be cut some distance from its termination in a muscle, and its irritability exhausted, it will first show signs of returning irritability nearest its distal extremity. Herrman experimented upon the sciatic nerve of a dog, which he exposed high, and cut, and exhausted its irritability. The distal portion of the sciatic being separated from the remainder of the nerve, and entirely cut off from the spinal system, could receive no recuperative power from that source. Yet it was found after a time to have regained its irritability, and perceptibly in a greater degree nearest its distal extremity. The interesting question as to how this nerve was able to resume for a time its normal condition, and to give rise to natural phenomena, can only be answered by admitting that, after being exhausted and rendered completely incapable of reacting to the usual stimuli, it has

recovered and been nourished from its distal extremity—whether through its ultimate connection with muscular fibre, or through a grosser circulation which exists between the muscular and nerve tissues.

If the inference drawn from this experiment be true, the local treatment of paralysis has been heretofore too much neglected, and a new method must be introduced, and a new hope inspired concerning the ultimate recovery of many forms of paralysis.

It is then a fallacious idea to think because the innervation of a muscle is cut off, that we should, therefore, wait until that necessary influence has been re-established before we can do anything to better the condition of the muscular fibre. Hence, I believe that in all forms of peripheral paralysis, from injury, cold, toxic influence, and the like, where not being able to restore the nerve to its normal condition, if we can by mechanical means give the affected muscles, as nearly as possible, their natural motions, we prevent any further degeneration in the muscles, and actually improve the condition of the nerve or nerves.

There are two results to be derived from the course of treatment advised in this paper: first, the muscular fibre is improved, and its condition rendered more natural; second, through the improvement of the muscles, the distal extremities of the nerves are affected favorably; and finally, the whole part is placed in the best hygienic condition to receive the influence of the will, as soon as the lesion should commence to disappear.

It is to be hoped, that as more attention is drawn to this method of treatment, closer investigation in regard to the muscular system will be invited, and that the principles advocated in this paper, heretofore totally neglected, will prove our best means of relieving many forms of paralysis.